

Abstract

Development and optimization of a method for the separation of natural humic substances from Lignite

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The presented work is carried out in cooperation with the Sieniawa Lignite Mine and has an implementation character.

Currently, lignite is almost entirely used for energy purposes. The unique properties of the raw material extracted in Sieniawa have allowed for the realisation of a project that aimed at developing a technology for manufacturing new products based on humic acids and/or their salts obtained through alkaline extraction of lignite, and their use outside the energy sector.

The literature section discusses the general situation of opencast mining in Poland and the world. Furthermore, it presents the potential of humic substances and their application in nonenergy sectors such as agriculture, environmental protection, animal nutrition, veterinary medicine, pharmacy, and medicine.

An analysis of the state of technology in the field of existing solutions was also carried out. The results of the analysis of the physicochemical properties of the elementary composition and infrared spectra of various types of lignite obtained in this study allowed the selection of coal with the best technological parameters useful to produce plant growth bio-stimulants and soil conditioners. Based on a series of laboratory analyses, statistical response surface models were developed. That allowed the selection and optimisation of the extraction process on a pilot scale. The individual steps of the technology were defined, and a mass balance was presented with the listing of products and the management of residues.

Based on observation of infrared spectra (FTIR) and elementary composition of the extracted humic acids, it was found that the obtained humic acids are rich in oxygen functional groups. They are characterised by higher carbon content and the presence of more aromatic groups than humic acids derived from peat or water. As a result of their introduction into the soil, we obtain a stable humus fraction rich in organic carbon. This will provide the right conditions for plant growth and contribute to improving the fertility of the soil.

The research carried out allowed for the implementation of efficient production technology on a pilot scale. The manufactured products are of high quality compared to commercial growth bio-stimulants and soil conditioners.